What Is Claimed Is:

1. A method for operating a resilient closed communication network comprising at least one communication ring, the method comprising the steps of:

receiving a data packet from a first external network at a first distributing station connected to the resilient closed communication network;

identifying a second distributing station connected to the resilient closed communication network from which the data packet is to be forwarded to a second external network;

determining functioning routes from the first distributing station to the second distributing station within the resilient closed communication network;

selecting an optimal route among the functioning routes; and

sending the data packet from the first distributing station to the second distributing station using the optimal route.

2. The method according to claim 1, wherein optimization factors including an available traffic volume, an actual distance value, and a preference value are considered in the selecting step.

3. The method according to claim 1, wherein the selecting step includes the steps of:

calculating an available traffic volume for each of the functioning routes;

maintaining a distance table containing information necessary to determine an actual distance value for each of the functioning routes;

finding optimal route candidates, which are routes with the smallest actual distance value among the functioning routes with a positive available traffic volume if at least one functioning

route has a positive available traffic volume, routes with the smallest actual distance value among the functioning routes with an available traffic volume of zero if the largest available traffic volume for the functioning routes is zero, or routes with the largest available traffic volume if all the functioning routes have a negative available traffic volume; and

choosing an optimal route from the optimal route candidates.

4. The method according to claim 3, wherein the choosing step uses a preference value to select an optimal route when there are at least two optimal route candidates.

5. The method according to claim 4, further comprising the step of prioritizing an order of sending the data packet when the optimal route has a negative available traffic volume.

6. The method according to claim 5, wherein the prioritizing step uses information contained in a transport layer of the data packet using an OSI model.

7. The method according to claim 3, further comprising the step of prioritizing an order of sending the data packet when the optimal route has a negative available traffic volume.

8. The method according to claim 7, wherein the prioritizing step uses information contained in a transport layer of the data packet using an OSI model.

9. The method according to claim 1, wherein no segment of the at least one communication ring is used as a dedicated protection segment.

10. The method according to claim 1, wherein the at least one communication ring is made of fiber optic cables.

11. The method according to claim 1, further comprising the steps of:

appending an identification number of the second distributing station to the data packet

before it leaves the first distributing station;

receiving the data packet at a third distributing station from the first distributing station; and

forwarding the data packet to the second external network connected to the third distributing station after removing the identification number from the data packet, if the identification number of the third distributing station is the same as the identification number appended to the data packet, or otherwise forwarding the data packet to a fourth distributing station that is different from the first distributing station.

12. The method according to claim 11, wherein optimization factors including an available traffic volume, an actual distance value, and a preference value are considered in the selecting step.

13. The method according to claim 11, wherein the selecting step includes the steps of:

calculating an available traffic volume for each of the functioning routes;

maintaining a distance table containing information necessary to determine an actual distance value for each of the functioning routes;

finding optimal route candidates, which are routes with the smallest actual distance value among the functioning routes with a positive available traffic volume if at least one of the functioning routes has a positive available traffic volume, routes with the smallest actual distance value among the functioning routes with an available traffic volume of zero if the largest available traffic volume for the functioning routes is zero, or routes with the largest available

1-WA/1349263.1

traffic volume if all the functioning routes have a negative available traffic volume; and

choosing an optimal route from the optimal route candidates.

14. The method according to claim 13, wherein the choosing step uses a preference value to select an optimal route when there are at least two optimal route candidates.

15. The method according to claim 14, further comprising the step of prioritizing an order of sending the data packet when the optimal route has a negative available traffic volume.

A1 Cont.

16. The method according to claim 15, wherein the prioritizing step uses information contained in a transport layer of the data packet using an OSI model.

17. The method according to claim 13, further comprising the step of prioritizing an order of sending the data packet when the optimal route has a negative available traffic volume.

18. The method according to claim 17, wherein the prioritizing step uses information contained in a transport layer of the data packet using an OSI model.

19. The method according to claim 11, wherein no segment of the at least one communication ring is used as a dedicated protection segment.

20. The method according to claim 11, wherein the at least one communication ring is made of fiber optic cables.

21. The method according to claim 1, further comprising the steps of:

appending an identification number of the second distributing station and a route segment data specifying the optimal route to the data packet before it leaves the first distributing station;

receiving the data packet at a third distributing station from the first distributing station; and

forwarding the data packet to the second external network connected to the third distributing station after removing the identification number and the route segment data, if the identification number of the third distributing station is the same as the identification number appended to the data packet, or otherwise forwarding the data packet to a fourth distributing station that is different from the first distributing station using the route segment data.

22. The method according to claim 21, wherein the forwarding step further includes the steps of:

if the identification number of the third distributing station is different from the identification number appended to the data packet,

extracting a route segment number of the route segment data;

removing the route segment number obtained in the extracting step from the route segment data; and

forwarding the data packet to a fourth distributing station using a route segment with the route segment number obtained in the extracting step.

23. The method according to claim 21, wherein optimization factors including an available traffic volume, an actual distance value, and a preference value are considered in the selecting step.

24. The method according to claim 21, wherein the selecting step includes the steps of:

calculating an available traffic volume for each of the functioning routes;

maintaining a distance table containing information necessary to determine an actual

distance value for each of the functioning routes;

finding optimal route candidates, which are routes with the smallest actual distance value among the functioning routes with a positive available traffic volume if at least one of the functioning routes has a positive available traffic volume, routes with the smallest actual distance value among the functioning routes with an available traffic volume of zero if the largest available traffic volume for the functioning routes is zero, or routes with the largest available traffic volume if all the functioning routes have a negative available traffic volume; and

choosing an optimal route from the optimal route candidates.

25. The method according to claim 24, wherein the choosing step uses a preference value to select an optimal route when there are at least two optimal route candidates.

26. The method according to claim 25, further comprising the step of prioritizing an order of sending the data packet when the optimal route has a negative available traffic volume.

27. The method according to claim 26, wherein the prioritizing step uses information contained in a transport layer of the data packet using an OSI model.

28. The method according to claim 24, further comprising the step of prioritizing an order of sending the data packet when the optimal route has a negative available traffic volume.

29. The method according to claim 28, wherein the prioritizing step uses information contained in a transport layer of the data packet using an OSI model.

30. The method according to claim 21, wherein no segment of the at least one communication ring is used as a dedicated protection segment.

31. The method according to claim 21, wherein the at least one communication ring is

made of fiber optic cables.

32. A method of operating a resilient closed communication network comprising at least one communication ring, a first distributing station, and a second distributing station wherein the first and the second distributing stations are interconnected by the at least one communication ring and have a router and a packet distributor, the method comprising the steps of:

A1 Cont.

receiving a data packet from a first external network at a first router in the first distributing station;

forwarding the data packet from the first router to a first packet distributor in the first distributing station;

identifying a network address of a second router in the second distributing station from which the data packet is to be forwarded to a second external network;

determining an identification number of a second packet distributor in the second distributing station;

appending the identification number of the second packet distributor to the data packet;

determining functioning routes from the first distributing station to the second distributing station within the resilient closed communication network;

selecting an optimal route among the functioning routes; and

sending the data packet from the first distributing station to the second distributing station using the optimal route.

33. The method according to claim 32, wherein optimization factors including an

available traffic volume, an actual distance value, and a preference value are considered in the selecting step.

34. The method according to claim 32, wherein the selecting step includes the steps of:

calculating an available traffic volume for each of the functioning routes;

maintaining a distance table containing information necessary to determine an actual distance value for each of the functioning routes;

finding optimal route candidates, which are routes with the smallest actual distance value among the functioning routes with a positive available traffic volume if at least one of the functioning routes has a positive available traffic volume, routes with the smallest actual distance value among the functioning routes with a traffic volume of zero if the largest available traffic volume of the functioning routes is zero, or routes with the largest available traffic volume if all the functioning routes have a negative available traffic volume; and

choosing an optimal route from the optimal route candidates.

35. The method according to claim 34, wherein the choosing step uses a preference value to select an optimal route when there are at least two optimal route candidates.

36. The method according to claim 35, further comprising the step of prioritizing an order of sending the data packet when the optimal route has a negative available traffic volume.

37. The method according to claim 36, wherein the prioritizing step uses information contained in a transport layer of the data packet using an OSI model.

38. The method according to claim 34, further comprising the step of prioritizing an order of sending the data packet when the optimal route has a negative available traffic volume.

Rt. Cont.

39. The method according to claim 38, wherein the prioritizing step uses information contained in a transport layer of the data packet using an OSI model.

40. The method according to claim 34, wherein no segment of the at least one communication ring is used as a dedicated protection segment.

41. The method according to claim 34, wherein the at least one communication ring is made of fiber optic cables.

42. The method according to claim 32, further comprising the steps of:

receiving the data packet at a third packet distributor in a third distributing station from the first distributing station; and

forwarding the data packet to a third router in the third distributing station from the third packet distributor for sending to the second external network connected to the third distributing station after removing the identification number from the data packet, if the identification number of the third packet distributor is the same as the identification number appended to the data packet, or otherwise forwarding the data packet to a fourth distributing station that is different from the first distributing station.

43. The method according to claim 42, wherein optimization factors including an available traffic volume, an actual distance value, and a preference value are considered in the selecting step.

44. The method according to claim 42, wherein the selecting step includes the steps of:

calculating an available traffic volume for each of the functioning routes;

maintaining a distance table containing information necessary to determine an actual

distance value for each of the functioning routes;

finding optimal route candidates, which are routes with the smallest actual distance value among the functioning routes with a positive available traffic volume if at least one of the functioning routes has a positive available traffic volume, routes with the smallest actual distance value among the functioning routes with a traffic volume of zero if the largest available traffic volume of the functioning routes is zero, or routes with the largest available traffic volume if all the functioning routes have a negative available traffic volume; and

choosing an optimal route from the optimal route candidates.

45. The method according to claim 44, wherein the choosing step uses a preference value to select an optimal route when there are at least two optimal route candidates.

46. The method according to claim 45, further comprising the step of prioritizing an order of sending the data packet when the optimal route has a negative available traffic volume.

47. The method according to claim 46, wherein the prioritizing step uses information contained in a transport layer of the data packet using an OSI model.

48. The method according to claim 44, further comprising the step of prioritizing an order of sending the data packet when the optimal route has a negative available traffic volume.

49. The method according to claim 48, wherein the prioritizing step uses information contained in a transport layer of the data packet using an OSI model.

50. The method according to claim 42, wherein no segment of the at least one communication ring is used as a dedicated protection segment.

51. The method according to claim 42, wherein the at least one communication ring is made of fiber optic cables.

52. The method according to claim 32 further comprising the steps of:

appending a route segment data for the optimal route to the data packet before the data packet leaves the first packet distributor;

receiving the data packet at a third packet distributor in a third distributing station from the first distributing station; and

forwarding the data packet to a third router in the third distributing station from the third packet distributor for sending to the second external network connected to the third distributing station after removing the identification number and the route segment data, if the identification number of the third packet distributor is the same as the identification number appended to the data packet, or otherwise forwarding to a fourth distributing station that is different from the first distributing station using the route segment data.

53. The method according to claim 52, wherein optimization factors including an available traffic volume, an actual distance value, and a preference value are considered in the selecting step.

54. The method according to claim 52, wherein the selecting step includes the steps of:

calculating an available traffic volume for each of the functioning routes;

maintaining a distance table containing information necessary to determine an actual distance value for each of the functioning routes;

finding optimal route candidates, which are routes with the smallest actual distance value among the functioning routes with a positive available traffic volume if at least one of the functioning routes has a positive available traffic volume, routes with the smallest actual distance

value among the functioning routes with a traffic volume of zero if the largest available traffic volume of the functioning routes is zero, or routes with the largest available traffic volume if all the functioning routes have a negative available traffic volume; and

choosing an optimal route from the optimal route candidates.

55. The method according to claim 54, wherein the choosing step uses a preference value to select an optimal route when there are at least two optimal route candidates.

56. The method according to claim 55, further comprising the step of prioritizing an order of sending the data packet when the optimal route has a negative available traffic volume.

57. The method according to claim 56, wherein the prioritizing step uses information contained in a transport layer of the data packet using an OSI model.

58. The method according to claim 54, further comprising the step of prioritizing an order of sending the data packet when the optimal route has a negative available traffic volume.

59. The method according to claim 58, wherein the prioritizing step uses information contained in a transport layer of the data packet using an OSI model.

60. The method according to claim 52, wherein no segment of the at least one communication ring is used as a dedicated protection segment.

61. The method according to claim 52, wherein the at least one communication ring is made of fiber optic cables.

62. The method according to claim 52, wherein the forwarding step further comprises the steps of:

if the identification number of the third packet distributor is different from the identification number appended to the data packet,

extracting a route segment number from the route segment data;

removing the route segment number obtained in the extracting step from the route segment data; and

A Cont.

forwarding the data packet to a fourth distributing station using a route segment with the route segment number obtained in the extracting step.

63. The method according to claim 32, wherein no segment of the at least one communication ring is used as a dedicated protection segment.

64. The method according to claim 32, wherein the at least one communication ring is made of fiber optic cables.

65. A resilient closed communication network comprising:

a first communication ring; and

at least two distributing stations interconnected by the first communication ring, each distributing station including:

means for receiving a data packet from an external network or from another distributing station in the resilient closed communication network;

means for identifying a destination distributing station for the data packet received from the external network;

means for appending the identification number for the destination distributing station to the data packet received from the external network;

means for determining functioning routes to the destination distributing station within the resilient closed communication network;

means for selecting an optimal route among the functioning routes; and

means for forwarding to the external network after removing the identification number from the data packet if the identification number of the distributing station is the same as the identification number appended to the data packet, or otherwise forwarding the data packet to a next distributing station based on the optimal route.

66. The resilient closed communication network according to claim 65, wherein the selecting means considers optimization factors including an available traffic volume, an actual distance value, and a preference value.

67. The resilient closed communication network according to claim 65, wherein the selecting means includes:

means for calculating an available traffic volume for each of the functioning routes;

means for maintaining a distance table containing information necessary to determine an actual distance value for each of the functioning routes;

means for finding optimal route candidates, which are routes with the smallest actual distance value among the functioning routes with a positive available traffic volume if at least one of the functioning routes has a positive available traffic volume, routes with the smallest available traffic volume if the largest available traffic volume among the functioning routes is zero, or routes with the largest available traffic volume if all the functioning routes have a negative available traffic volume; and

means for choosing an optimal route from the optimal route candidates.

68. The resilient closed communication network according to claim 67, wherein the choosing means uses a preference value to choose an optimal route when there are at least two optimal route candidates.

69. The resilient closed communication network according to claim 68, wherein each distributing station further includes means for prioritizing an order of sending the data packet when the optimal routes has a negative available traffic volume.

70. The resilient closed communication network according to claim 69, wherein the prioritizing means uses information contained in a transport layer of the data packet using an OSI model.

71. The resilient closed communication network according to claim 67, wherein each distributing station further includes means for prioritizing an order of sending the data packet when the optimal route has a negative available traffic volume.

72. The resilient closed communication network according to claim 71, wherein the prioritizing means uses information contained in a transport layer of the data packet using an OSI model.

73. The resilient closed communication network according to claim 67, wherein no segment of the first communication ring is used as a dedicated protection segment.

74. The resilient closed communication network according to claim 67, wherein the first communication ring is made of fiber optic cables.

75. The resilient closed communication network according to claim 65, wherein no segment of the first communication ring is used as a dedicated protection segment.

76. The resilient closed communication network according to claim 65, wherein the first communication ring is made of fiber optic cables.

77. A resilient closed communication network comprising:

a first communication ring; and

at least two distributing stations interconnected by the first communication ring, each distributing station including:

means for receiving a data packet from an external network or from another distributing station in the resilient closed communication network;

means for identifying a destination distributing station for the data packet received from the external network;

means for appending the identification number for the destination distributing station to the data packet received from the external network;

means for determining functioning routes to the destination distributing station within the resilient closed communication network;

means for selecting an optimal route among the functioning routes;

means for appending a route segment data for the optimal route to the data packet received from the external network, and

means for forwarding to the external network after removing the identification number and the route segment data from the data packet if the identification number of the distributing station is the same as the identification number appended to the data packet, or otherwise forwarding to a next distributing station using a route segment specified in the route segment data after updating the route segment data.

78. The resilient closed communication network according to claim 77, wherein the

selecting means considers optimization factors including an available traffic volume, an actual distance value, and a preference value.

79. The resilient closed communication network according to claim 77, wherein the selecting means includes:

means for calculating an available traffic volume for each of the functioning routes;

means for maintaining a distance table containing information necessary to determine an actual distance value for each of the functioning routes;

A1 cont

means for finding optimal route candidates, which are routes with the smallest actual distance value among the functioning routes with a positive available traffic volume if at least one of the functioning routes has a positive available traffic volume, routes with the smallest available traffic volume if the largest available traffic volume among the functioning routes is zero, or routes with the largest available traffic volume if all the functioning routes have a negative available traffic volume; and

means for choosing an optimal route from the optimal route candidates.

80. The resilient closed communication network according to claim 79, wherein the choosing means uses a preference value to choose an optimal route when there are at least two optimal route candidates.

81. The resilient closed communication network according to claim 80, wherein each distributing station further includes means for prioritizing an order of sending the data packet when the optimal routes has a negative available traffic volume.

82. The resilient closed communication network according to claim 81, wherein the prioritizing means uses information contained in a transport layer of the data packet using an OSI

model.

83. The resilient closed communication network according to claim 79, wherein each distributing station further includes means for prioritizing an order of sending the data packet when the optimal route has a negative available traffic volume.

84. The resilient closed communication network according to claim 83, wherein the prioritizing means uses information contained in a transport layer of the data packet using an OSI model.

85. The resilient closed communication network according to claim 79, wherein no segment of the first communication ring is used as a dedicated protection segment.

86. The resilient closed communication network according to claim 79, wherein the first communication ring is made of fiber optic cables.

87. The resilient closed communication network according to claim 77, wherein no segment of the first communication ring is used as a dedicated protection segment.

88. The resilient closed communication network according to claim 77, wherein the first communication ring is made of fiber optic cables.

89. A resilient closed communication network comprising:

a first communication ring; and

at least two distributing stations interconnected by the first communication ring, each distributing station including:

a router capable of receiving a data packet from an external network connected to the distributing station and of forwarding the data packet to the external network connected to the distributing station; and

a packet distributor comprising:

means for receiving a data packet from the router in the same distributing station or from another distributing station in the resilient closed communication network;

means for identifying a network address of a destination router in the destination distributing station for the data packet received from the router in the same distributing station;

means for determining an identification number of a destination packet distributor in the destination distributing station;

means for appending the identification number of the destination packet distributor to the data packet received from the router in the same distributing station;

means for determining functioning routes to the destination distributing station within the resilient closed communication network;

means for selecting an optimal route among the functioning routes; and

means for forwarding the data packet to the router in the same distributing station after removing the identification number from the data packet if the identification number of the distributing station is the same as the identification number appended to the data packet, or

A1 Cont'd

otherwise forwarding the data packet to a next distributing station.

90. The resilient closed communication network according to claim 89, wherein the selecting means considers optimization factors including an available traffic volume, an actual distance value, and a preference value.

91. The resilient closed communication network according to claim 89, wherein the selecting means includes:

means for calculating available traffic volume for each of the functioning routes;

means for maintaining a distance table containing information necessary to determine an actual distance value for each of the functioning routes;

means for finding optimal route candidates, which are routes with the smallest actual distance value among the functioning routes with a positive available traffic volume if at least one of the functioning routes has a positive available traffic volume, routes with the smallest available traffic volume if the largest available traffic volume among the functioning routes is zero, or routes with the largest available traffic volume if all the functioning routes have a negative available traffic volume; and

means for choosing an optimal route from the optimal route candidates.

92. The resilient closed communication network according to claim 91, wherein the choosing means uses a preference value to select an optimal route when there are at least two optimal route candidates.

93. The resilient closed communication network according to claim 92, wherein each distributing station further includes means for prioritizing an order of sending the data packet when the optimal routes has a negative available traffic volume.

94. The resilient closed communication network according to claim 93, wherein the prioritizing means uses information contained in a transport layer of the data packet using an OSI model.

95. The resilient closed communication network according to claim 91, wherein each distributing station further includes means for prioritizing an order of sending the data packet when the optimal routes has a negative available traffic volume.

96. The resilient closed communication network according to claim 95, wherein the prioritizing means uses information contained in a transport layer of the data packet using an OSI model.

97. The resilient closed communication network according to claim 91, wherein no segment of the first communication ring is used as a dedicated protection segment.

98. The resilient closed communication network according to claim 91, wherein the first communication ring is made of fiber optic cables.

99. The resilient closed communication network according to claim 89, wherein no segment of the first communication ring is used as a dedicated protection segment.

100. The resilient closed communication network according to claim 89, wherein the first communication ring is made of fiber optic cables.

101. A resilient closed communication network comprising:

a first communication ring; and

at least two distributing stations interconnected by the first communication ring, each distributing station including:

a router capable of receiving a data packet from an external network connected to the distributing station and of forwarding the data packet to the external network connected to the distributing station; and

a packet distributor comprising:

means for receiving a data packet from the router in the same distributing station or from another distributing station in the resilient closed communication network;

means for identifying a network address of a destination router in the destination distributing station for the data packet received from the router in the same distributing station;

means for determining an identification number of a destination packet distributor in the destination distributing station;

means for appending the identification number of the destination packet distributor to the data packet received from the router in the same distributing station;

means for determining functioning routes to the destination distributing station within the resilient closed communication network;

means for selecting an optimal route among the functioning routes;

means for appending a route segment data for the optimal route to the data packet received from the router in the same distributing station; and

means for forwarding the data packet to the router in the same distributing station after

removing the identification number and the route segment data from the data packet if the identification number of the distributing station is the same as the identification number appended to the data packet, or otherwise forwarding to a next distributing station using a route segment specified in the route segment data after updating the route segment data.

102. The resilient closed communication network according to claim 101, wherein the selecting means considers optimization factors including an available traffic volume, an actual distance value, and a preference value.

A' Cont.

103. The resilient closed communication network according to claim 101, wherein the selecting means includes:

means for calculating available traffic volume for each of the functioning routes;

means for maintaining a distance table containing information necessary to determine an actual distance value for each of the functioning routes;

means for finding optimal route candidates, which are routes with the smallest actual distance value among the functioning routes with a positive available traffic volume if at least one of the functioning routes has a positive available traffic volume, routes with the smallest available traffic volume if the largest available traffic volume among the functioning routes is zero, or routes with the largest available traffic volume if all the functioning routes have a negative available traffic volume; and

means for choosing an optimal route from the optimal route candidates.

104. The resilient closed communication network according to claim 103, wherein the choosing means uses a preference value to select an optimal route when there are at least two optimal route candidates.

105. The resilient closed communication network according to claim 104, wherein each distributing station further includes means for prioritizing an order of sending the data packet when the optimal routes has a negative available traffic volume.

106. The resilient closed communication network according to claim 105, wherein the prioritizing means uses information contained in a transport layer of the data packet using an OSI model.

107. The resilient closed communication network according to claim 103, wherein each distributing station further includes means for prioritizing an order of sending the data packet when the optimal routes has a negative available traffic volume.

108. The resilient closed communication network according to claim 107, wherein the prioritizing means uses information contained in a transport layer of the data packet using an OSI model.

109. The resilient closed communication network according to claim 103, wherein no segment of the first communication ring is used as a dedicated protection segment.

110. The resilient closed communication network according to claim 103, wherein the first communication ring is made of fiber optic cables.

111. The resilient closed communication network according to claim 101, wherein no segment of the first communication ring is used as a dedicated protection segment.

112. The resilient closed communication network according to claim 101, wherein the first communication ring is made of fiber optic cables.